Nov. 10 '83

A SUMMARY REVIEW

The 1983 Maine Spruce Budworm Spray Program, Spruce Budworm Population Conditions in 1983, and a Forecast for 1984.

Maine Forest Service
DEPARTMENT OF CONSERVATION
Report to the Eastern Spruce Budworm Council

November 7, 1983

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Spray Project Operations

The Maine Forest Service treated 846,382 acres (342,665 hectares) of spruce budworm infested forest land in 1983 with biological and chemical insecticides. Table 1 indicates the various insecticides used and the acreage treated with each. Total cost of the 1983 Spruce Budworm Management Program was $5.862 million (U.S.) or $6.93 per acre sprayed ($17.12/hectare), a significant reduction in cost from the 1982 program. Cost savings were accomplished primarily through the elimination of rotary wing aircraft and a switch to Matacil 180F^{R} as the principal chemical insecticide. A breakdown of program costs by major component is shown in Table 2.

Spray operations began on May 25 (A.M.) and were completed on June 23 (A.M.) Budworm development and spray operations were hampered during the first 10 days of the project by cool, damp weather. The weather then became very warm and dry and continued so through the remainder of the operational period.

Project Headquarters was again centered at Presque Isle and seven air bases of operation were utilized in northern and eastern Maine. Figure 1 shows the 1983 spray area. Tables 3 and 4 contain information on acres treated by airport and gallons by aircraft type, respectively.

Funding for the 1983 Maine program was generated from an excise tax assessed on participating landowners. In addition, the State's General Fund contributed $108,596 to support budworm research and survey activities, and the USDA Forest Service contributed $98,000 to support the Small Landowner Assistance Program.

TABLE 1. Insecticides Used and Acres Treated, 1983 Maine Spruce Budworm Program.

	Acres (Hectares)	Percent of Total
Matacil 180F (aminocarb)	632,953 (256,256)	75%
Sevin-4-Oil (carbaryl)	89,498 (36,234)	11%
Orthene Forest Spray (acephate)	4,627 (1,873)	1%
Dipel 6L (Bt)	25,814 (10,451)	3%
Dipel 4L (Bt)	2,954 (1,196)	--
Thuricide 32LV (Bt)	80,205 (32,472)	9%
Thuricide 24 B (Bt)	8,479 (3,433)	1%
Bactospeine (Bt)	1,852 (750)	--
TOTAL	846,382 (342,665)	100%

TABLE 2. 1983 Maine Spruce Budworm Management Program Cost Summary

ITEM	COST ($1,000 U.S.)
Spray Aircraft	$1,446
Monitor/Admin. Aircraft	181
Survey Aircraft	33
Insecticide	1,600
Fuel Oil #1	158
Mixing/Loading	428
Personal Services	1,156
Food/Lodging	99
Research	157
Health Monitoring	52
Equipment	56
Operating Expenses	497
TOTAL	$5,863

Acres treated = 846,382

Cost per acre = $6.93 (U.S.)

Cost per Hectare = $17.12 (U.S.)

FIGURE 1. 198 Project Spray Area

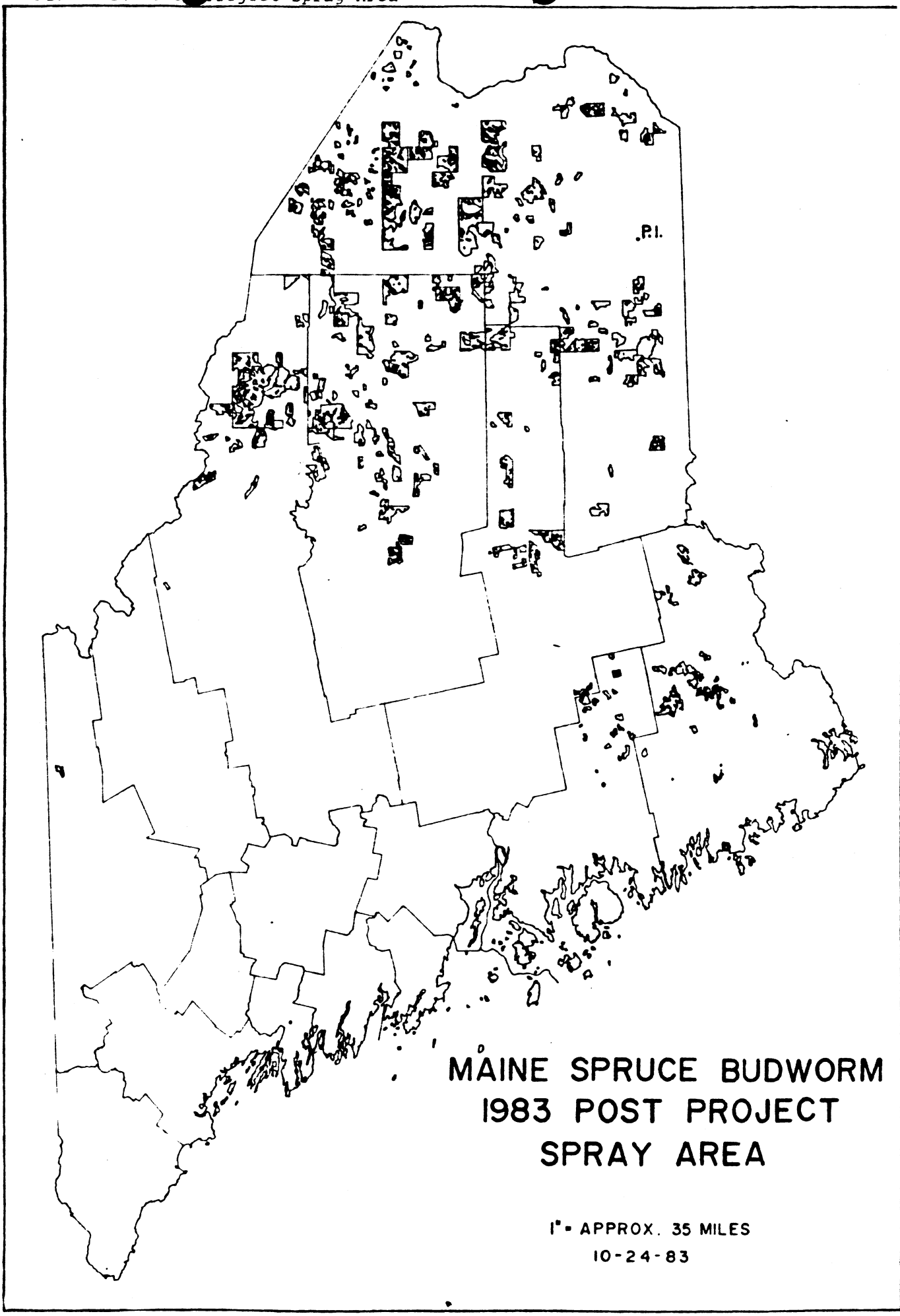

TABLE 3. Acres Treated by Airport, 1983 Maine Spruce Budworm Spray Program.

AIRPORT	ACRES (HECTARES) TREATED		PERCENTAGE OF TOTAL
Presque Isle	501,240	(202,931)	59%
Millinocket	103,556	(41,926)	12%
Red Pine	76,844	(31,111)	9%
Frenchville	53,792	(21,778)	6%
Princeton	49,415	(20,006)	6%
Jackman	48,870	(17,761)	5%
Old Town	17,665	(7,152)	2%
	846,382	(342,665)	99%*

*Does not total 100% due to rounding of individual figures

TABLE 4. Gallons Sprayed by Aircraft Type, 1983 Maine Spruce Budworm Program.

AIRCRAFT & SPRAY SYSTEM	GALLONS	PERCENTAGE OF TOTAL
C-54, boom & nozzle	111,149	40%
M-18, micronair	37,047	13%
Thrush, micronair	47,174	17%
Thrush, boom & nozzle	49,140	18%
Airtractor, micronair	16,880	6%
Airtractor, boom & nozzle	16,251	6%
TOTAL	277,941	100%

Long-Term Environmental Monitoring Project

The Maine Forest Service initiated the first year of a Long-Term Environmental Monitoring project in 1983. A private contactor was chosen to initiate the project by collecting data on terrestrial and aquatic vertebrate and invertebrate populations, plant communities, abiotic factors, and ecosystem functions on twenty-two fixed sample plots throughout Maine's spruce fir forest. The project is scheduled to last 5 years and should provide insights into the long term effects of spraying and budworm defoliation on terrestrial and aquatic ecosystems.

Private Spray Programs

In addition to the Maine Forest Service Program, six private spruce budworm spray programs treated a total of 165,000 acres in Maine in 1983. International Paper Company sprayed 104,000 acres in northern Maine with aminocarb, mexacarbate and Bt. J.D. Irving Company sprayed 20,000 acres in northern Maine with aminocarb. The Passamoquoddy Indians treated 30,000 acres, and Baskahegan Company 8,000 acres respectively with Bt in Washington County. The Town of Garfield treated 1,000 acres with aminocarb and Blanchette treated 2,000 acres with Bt.

PRELIMINARY RESULTS

MAINE SPRUCE BUDWRORM SUPPRESSION PROJECT, 1983

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AUGUST, 1983

INTRODUCTION

In 1983, the Maine Forest Service conducted an aerial spray program against the spruce budworm beginning on May 25th and ending on June 23rd. The project covered 848,624 acres and involved the use of eight insecticides applied at ten rates. Timing of each rate was based on the insecticide used, the population, and the major target host (spruce or fir). Orthene was applied in a single application, but all other chemicals were applied as a split application. All Bt was applied as a single 12 B.I.U. application. The major portion of the acreage (635,331 acres) was sprayed with Matacil 180 F in a split application. The remaining project area was sprayed with Sevin-4-Oil (89,441 acres), Orthene (4,624 acres) or with one of five Bt products (119,228 acres). Bt products used were Dipel 4L, Dipel 6L, Thuricide 32LV, Thuricide 24B, and Bactospiene.

Most of the blocks treated in 1983 had been protected for two or three years prior to 1983 and were in fair prespray condition. Exceptions to this generalization occurred in new blocks added in Hancock, Washington Counties and in a few scattered blocks in northern Maine. These blocks were in critical condition prior to the 1983 operation. Surveys predicted extreme populations in all of northwestern Maine. Populations were as predicted and higher than any seen since 1978.

DEVELOPMENT, SPRAY TIMING, AND WEATHER

Larval instar development and the expansion of host tree buds were closely monitored in order to properly time the release of spray blocks. Data were collected every three days from fifteen permanent development locations throughout the State. Each sample provided a larval index and a bud index. When the index of a permanent point in the vicinity of treatment blocks approached the desired release timing, spot developments were initiated within the blocks for final timing. The desired timing for each treatment variation is shown in Table 5.

A large number of spot developments were taken in 1983 to properly time applications. Spot developments were especially important for timing the first applications in spruce stands. Timing in these areas required direct observations of the position of insects and the swelling of shoots.

TABLE 5. TREATMENT VARIATIONS EVALUATED IN THE 1983 MAINE SPRUCE BUDWORM CONTROL PROJECT INCLUDING PLANNED TREATMENT TIMING

INSECTICIDE	RATE ACTIVE INGREDIENT (OZS.)	FINAL SPRAY VOLUME OZS.	AIRCRAFT	NUMBER OF APPLICATIONS	TIMING*
MATACIL	1.0	20	C-54 THRUSH M-18	2	1,2,3
SEVIN-4-OIL	6.0	24	C-54 THRUSH	2	1,2
ORTHENE	8.0	64	THRUSH	1	4
DIPEL 6L	12 B.I.U.	64 32	THRUSH M-18	1	4
DIPEL 4L	12 B.I.U.	48	THRUSH	1	4
THURICIDE 32LV	12 B.I.U.	64 48	THRUSH M-18	1	4
THURICIDE 24B	12 B.I.U.	96	M-18	1	4
BACTOSPIENE	12 B.I.U.	64	THRUSH	1	4

*TIMING:

1. 1st application before larvae enter spruce buds; 2nd application 5th or early 6th instar.
2. 1st application 50 to 70% 4th instar; 2nd application 5 to 7 days later.
3. Both applications before larvae enter spruce buds.
4. Peak 4th instar.

The larval development season in 1983 was unusual containing two radically different and long lasting weather patterns. During the early instars in May and early June the weather was cool and wet. Rain fell nearly every day. In early June the weather changed to a very hot, dry pattern, which lasted through the remainder of the project. Temperatures were in the 80's for most of this period.

Larval development during the early wet weather was extremely slow. Larvae emerged at or slightly before normal, but quickly became retarded in their development. Larvae were very inactive during the cool, wet weather and fed very little. By the 4th instar, larval development was 10 to 14 days slower than normal.

Larval development was very fast during the hot, dry weather. After about two weeks of hot, dry weather development had quickened to a pace only slightly slower than normal.

Shoot development was also drastically affected by the unusual weather. The cool, wet weather seemed to be favorable for fir shoot development. By the late 3rd instar, fir shoots were well elongated with individual needle tips showing (Index 4). The shoot development index was advanced relative to the larval index.

Shoot development data is not kept for spruce, but observations suggest that spruce was not advanced as was fir. Red spruce buds broke at the normal time or later than normal in some areas.

Wet weather in May and early June delayed first applications in some areas, but most treatments were delayed for five days or less. Very slow development during this period caused these delays to be insignificant in terms of defoliation. The second application of several blocks was also delayed by weather, however, these delays were caused by high temperatures, haze, and wind. Delays were generally less than seven days, but even four to five days under very hot, dry conditions resulted in measurable losses of foliage. Most notable losses were seen on fir in the northwest.

APPLICATION VARIATIONS AND TIMING

Several application variations were used in 1983 (Table 5). Most of the project area was treated with split applications of Matacil or Sevin-4-Oil. Most splits were timed such that the first application occurred before larvae entered the spruce buds and the second application was planned for peak 5th instar or red spruce bud break, whichever occurred first. This timing was used in red spruce areas and where red spruce made up an important portion of the stand. In areas stocked predominantly with fir, the first application was applied when 50 to 70 percent of the larvae were 4th instar (Index 3.4 to 3.7) and the second application was applied five to seven days later. Both variations were expected to provide good fir protection, but the later second application was expected to provide better spruce protection. In 1983, 1st application release came at about the same time for both timing variations because larvae were slow to enter the spruce buds. Usually the two timing regimes differ by two to five days. Often larvae move from the needle to

around spruce buds in the 3rd instar, but in 1983 the wet weather delayed the move until most larvae were in the 4th instar. One small block was sprayed twice with Matacil before the larvae entered the spruce buds. This timing was used with Sevin-4-Oil in a similar test in 1982 with good results in terms of spruce protection.

All Orthene and Bt products were applied as a single application. Orthene was sprayed at the 8 oz. per acre A.I. rate and all Bt at 12 B.I.U.. Spray regimes used for the various Bt products varied considerably. Dipel 6L, Thuricide 32LV and Bactospiene were all applied at the 64 oz. rate. In addition, Dipel 4L, Dipel 6L, and Thuricide 32LV were applied undiluted at 48, 32 and 48 oz. respectively. Thuricide 24B was applied at 96 ozs. per acre rate.

Orthene and all Bt products were timed for peak 4th instar. A well expanded fir shoot target was also necessary for block release (Index 3.5 to 4.0)

PRE-SPRAY POPULATION LEVELS

Population levels in all spray areas were evaluated prior to spraying (Figure 2). These evaluations allow for deletion of low population areas and finalization of block release timing based on spring populations.

Extreme populations were found in northwestern and northcentral Maine (26 to 70 larvae per 18 inch branch tip) (Figure 2). High and very high levels were found in the northeast, the Rangeley area, and in portions of the southeast. Other areas were found to be moderate with the exceptions of low counts in blocks treated for the last few years in the west and some blocks in the Millinocket area.

In many areas, large variations were noted between fir and spruce counts. Extreme counts on spruce and low or moderate counts on fir were found in many areas. In most cases spruce had high counts. In some spruce survey lines, individual inter-tree counts varied as much as 200 larvae per tip.

As a direct result of the 1983 prespray survey six blocks containing about 16,501 acres in western and central Maine were dropped from the project. These blocks were all found to have low populations.

PRESPRAY HOST CONDITIONS

Host tree condition was fair or good (terms referring to the stands ability to recover if sprayed) in blocks which had been sprayed two or three times since 1978. Most of these protected blocks were in northwestern or northeastern Maine. Some blocks in the northwest were sprayed for the first or second time in several years and these blocks were in poor condition.

Many blocks in Washington, Hancock, and Penobscot Counties have not been protected aggressively in the past five years and host trees in these areas were in poor or critical condition. Many blocks in these areas had some

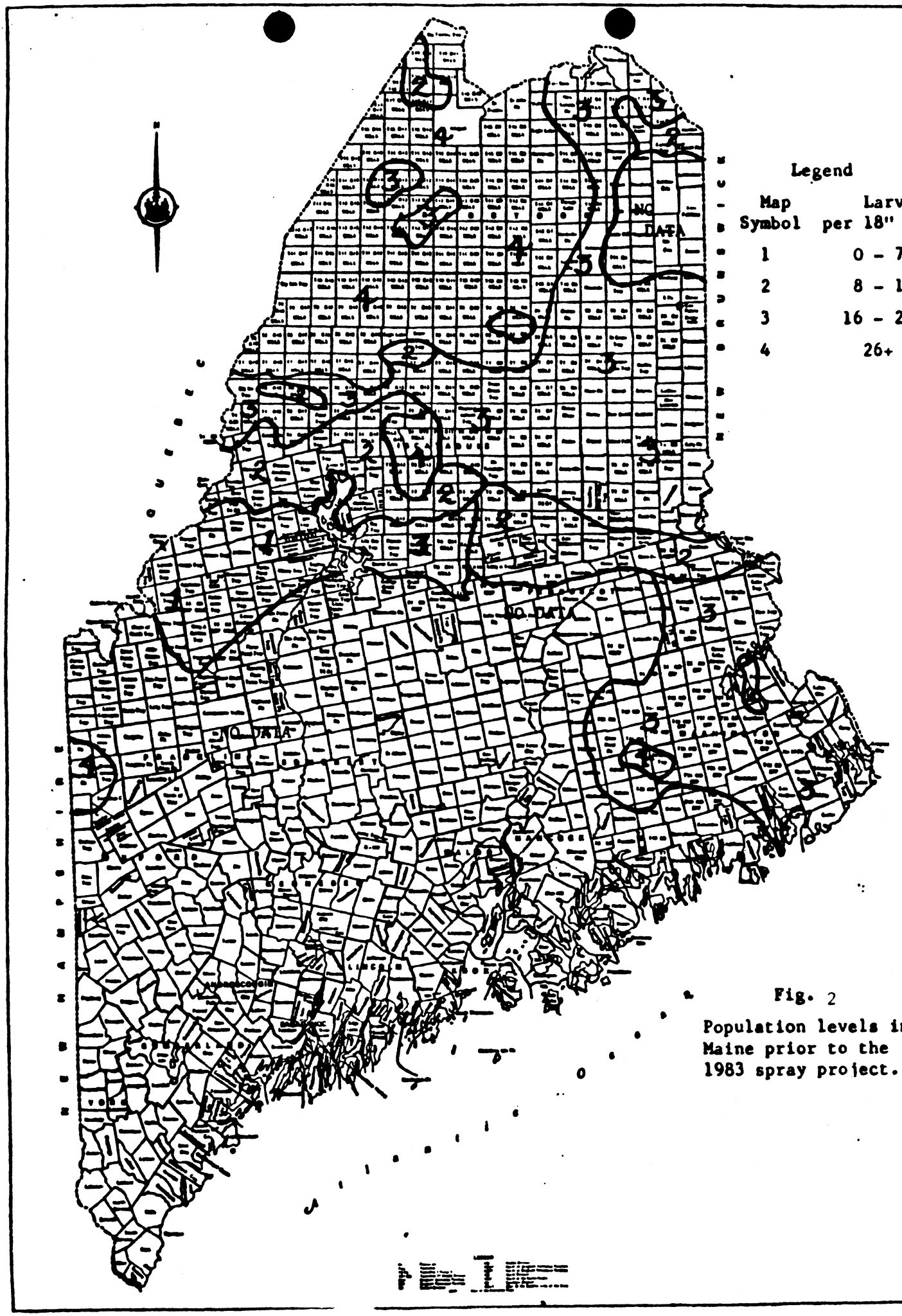

Fig. 2
Population levels in Maine prior to the 1983 spray project.

volume of dead fir and were designated for spruce protection. Tree condition in Washington County and southern Aroostook Counties blocks that were treated in 1981 and 1982 were generally improved by spraying and were in fair condition.

Stands in the southwestern treatment area were generally in good condition. Low populations throughout the southwest in 1981 and 1982 resulted in good foliage crops on trees still able to produce buds. These improved conditions aided in the decision to drop several of these blocks from the 1983 program.

The amount of dead wood in unprotected areas and buffers in the spring of 1983 was impressively high. Large volumes of dead wood can now be found anywhere in the infested area where protection has been withheld. The volume of dead spruce in the north and southeast is increasing dramatically.

SPRAY RESULTS

Spray results will be reported for each treatment variation employed in the 1983 operation. Many of the treatment variations used were evaluated in several areas and each area is listed separately. Tables 6 and 7 list spray results for chemical insecticides and Bt respectively. Results are presented as the number of survivors per 18 inch tip, unadjusted mortality, defoliation in sprayed areas, and foliage saved (defoliation in the unsprayed check minus defoliation in the blocks) for fir, spruce, and in some areas, hemlock.

Methods for efficacy determination of the 1983 project are shown in Sampling and Analysis Design For Experimental Insecticide Monitoring (Maine Forest Service Technical Report No. 12, Kemp, et. al., 1979) and the Maine Forest Service Spruce Budworm Survey and Assessment Manual (MFS Technical Report in preparation).

Data presented is preliminary and results may change somewhat in the final report due to additional analysis.

The 1983 spray project had variable results, with much of the treatment area showing more damage than had been seen in the 1979 through 1982 seasons. Despite this general observation of poorer results, most blocks showed acceptable foliage protection and population reduction compared to relevant untreated checks.

Unadjusted population reduction ranged from 82 to 99 percent with chemical insecticides and from 73 to 98 percent with Bt. The highest and most consistent reductions were in Sevin blocks. Generally, unadjusted mortality was extremely variable with Matacil and Bt products and the majority of lines evaluated showed higher survival than in years 1979 to 1982. Higher survival occurred in scattered blocks throughout the project area and on both fir and spruce. Areas of consistent high or low suvival were not seen as was the case in 1982. The variability in survival seems to be related to inconsistent spray results and unusual weather conditions.

Natural mortality in untreated areas was also extremely variable, probably due to weather. Mortality in checks ranged from 98 to 40 percent. Mortality was generally higher on spruce than on fir, but variability was seen with both

TABLE 6. RESULTS OF CHEMICAL INSECTICIDE TREATMENT VARIATIONS BY AREA FOR THE 1983 MAINE SPRUCE BUDWORM CONTROL PROJECT

Treatment	Area	Host	No. Sur. Per 18" Tip	% Red. Unadj.	% Def.	% Fol. Saved
MATACIL						
Split Application						
1.0 oz. + 1.0 oz.						
A.I. in 20 oz.						
Early/Late						
Small Aircraft	A48, A50 T15R14	F	3.45	81.8	78.0	19.6
		S	1.05	93.7	66.6	22.2
	B48, B49	F	2.93	82.7	58.8	23.9
	T28 MD	S	4.07	83.6	31.1	31.0
		H	3.65	85.9	25.8	36.7
	B10, Stockholm	F	0.13	99.7	64.8	30.6
		S	0.40	98.8	44.3	41.4
	C63, T10R16	F	0.50	98.8	70.7	26.9
		S	0.47	98.6	49.9	39.7
	M57, M59, M84	F	1.78	89.4	33.8	22.5
	Princeton Area	S	0.67	97.0	53.4	31.8
		H	1.48	91.1	25.4	25.0
Early/Late						
Large Aircraft	A30, T16R12	F	4.33	85.2	94.1	3.5
		S	2.33	90.3	78.5	10.3
	F 1, T8R13	F	0.40	97.7	14.6	63.9
		S	0.70	95.1	47.4	39.0
	G 1, G12 ,T10R7	F	0.67	97.6	19.7	46.2
		S	0.70	97.3	47.6	32.9
	B18, T14R7	F	1.13	96.5	67.9	27.5
		S	0.67	97.9	35.9	49.8
	D10, T12R9	F	1.27	97.3	89.3	8.3
		S	0.87	97.8	68.7	20.1
	D25, T10R12	F	0.27	97.4	17.6	72.4
		S	0.07	99.5	45.0	43.8
	E46, E10,	F	4.49	75.5	69.4	28.2
	Russell Pd. Area	S	1.85	92.1	40.5	48.3
Early/Early	M70, Alligator Lk.	F	2.93	85.7	20.0	26.9
		S	0.80	97.6	28.4	25.1
		H	3.56	77.9	28.7	28.4

TABLE 6 (CONTINUED). RESULTS OF CHEMICAL INSECTICIDE TREATMENT VARIATIONS BY AREA FOR THE 1983 MAINE SPRUCE BUDWORM CONTROL PROJECT

Treatment	Area	Host	No. Sur. Per 18" Tip	% Red. Unadj.	% Def.	% Fol. Saved
SEVIN-4-OIL						
6.0 oz. + 6.0 oz						
A.I. in 24 oz.						
Early/Late	F18, F21; T8R8	F	0.48	98.1	28.7	43.0
		S	0.18	99.3	39.1	36.1
	A59	F	0.40	98.9	84.5	13.1
	T15R10	S	0.67	99.0	20.4	68.4
	E 8, T6R18	F	1.33	95.6	58.5	39.1
		S	0.13	99.3	26.1	62.7
Orthene						
8 oz. in 64 ozs.						
Peak 4th	Not Available at this time					

TABLE 7. RESULTS OF BT INSECTICIDE TREATMENT
VARIATIONS BY AREA FOR THE 1983 MAINE SPRUCE BUDWORM CONTROL PROJECT

Treatment	Area	Host	No. Sur. Per 18" Tip	% Red. Unadj.	% Def.	% Fol. Saved
DIPEL 6L 12 B.I.U. in 64 ozs.	G 46, Smyrna	F	2.20	73.0	47.1	25.7
		S	2.05	85.5	58.7	13.5
	M82, M111; T26ED	F	2.12	93.6	44.6	43.6
		S	0.80	97.4	26.0	45.3
		H	2.27	89.3	34.1	33.8
	M72, M73; T34MD SMALL TREES	F	0.80	81.3	12.3	18.1
		S	0.73	90.4	13.8	16.6
	M121	F	3.67	78.7	26.1	33.4
		S	3.47	79.7	20.0	41.6
		H	0.33	97.8	6.3	26.4
DIPEL 4L 12 B.I.U. in 48 oz. Undiluted	M 5; Danforth	F	0.83	94.5	15.1	36.1
		S	0.55	96.4	16.4	16.4
DIPEL 6L 12 B.I.U. in 32 oz. Undiluted	M 10; Topsfield	F	0.95	87.5	28.4	22.8
		S	0.52	86.6	20.9	11.9
THURICIDE 32LV 12 B.I.U. IN 64 Ozs.	G 26; T9R3	F	0.75	91.3	52.2	20.6
		S	0.35	97.4	34.1	38.1
	B 5; T17R5	F	2.80	88.6	45.6	27.0
		S	1.53	93.7	59.1	13.1
THURICIDE 32LV 12 B.I.U. IN 48 oz. Undiluted	B 13; Stockholm	F	2.10	85.4	56.9	34.3
		S	0.43	96.9	24.3	47.9
THURICIDE 24B 12 B.I.U. in 96 ozs.	J12; Medway	F	1.40	91.2	33.4	45.6
		S	1.27	91.8	13.1	38.0
BACTOSPIENE 12 B.I.U. in 64 ozs.	G 27; T8R3	F	1.01	86.7	45.6	27.2
		S	1.63	81.9	42.8	29.4

species. Variability occurred within areas and even within assessment lines.

Untreated survival is used to calculate mortality adjusted by the Abbott's formula. However, the variability of survival in checks meant that the Abbott's formula correction was meaningless and thus not used.

Defoliation was generally heavier in 1983 than has been seen in the last few seasons, but treated areas have much less defoliation than untreated checks. Distinguishing treated and untreated areas during the aerial survey was extremely easy.

In the years 1979 to 1982 defoliation in sprayed areas was 30 to 50 percent of the expected defoliation (based on unsprayed checks). Figures in 1983 showed less foliage saved than past years. Defoliation was 40 to 70 percent of the expected. Foliage saved figures in the northwest were very low in some blocks due to high larvae counts. If larval feeding on one year old foliage (back feeding) had been considered (added to the defoliation level in check areas), foliage saved would be much higher. Little back feeding was observed in spray areas.

Mean defoliation to fir in sprayed areas ranged 94 to 17 percent with the highest defoliation occurring in the northwest. Fir defoliation in most blocks was an acceptable 40 to 60 percent compared to near 100 percent defoliation in many untreated areas.

Fir defoliatioon was low in the more moderate population areas and in areas receiving good spray coverage. Fir defoliation in some of the large aircraft areas was high due to very high larval counts and delays in the second application due to bad weather.

Fir in spray blocks generally appeared to have less defoliation when observed during the aerial survey than when observed from the ground. This variation was due to lower defoliation on tree tops than on lower and middle crowns as confirmed by occular estimates taken for each crown segment. Less upper crown defoliation was probably due to much better spray deposit on tree tops. The advanced flush and rapid growth of fir foliage probably resulted in much of the spray being intercepted by upper crown foliage, thus not reaching the lower and middle crowns.

Mean defoliation to spruce range from 78 to 12 percent again, with the highest levels in the northwest. Most blocks were 40 to 60 percent defoliated in 1983 compared to 25 to 50 percent levels in past seasons. Spruce defoliation in untreated checks was much higher than normal with most areas 60 to 90 percent defoliated.

In general, spruce defoliation in both treated and untreated areas was far heavier than normal in 1983. Differences between 1983 and past years may include; heavier than normal larval population, unusual larvae/spruce synchrony, or less effective spray results on spruce.

In many treated blocks a portion of the spruce had moderate or even heavy defoliation, but the remainder of the spruce and the fir in the block would have only light defoliation. This "spotty" defoliation on spruce was not due to spray misses, but rather to extreme variability of population and timing of

bud flush between spruce trees.

Hemlock defoliation was lower than in past years, in most cases 20 to 30 percent. This is probably due to lower counts in the southeast where most hemlock is found.

The best and most consistent foliage protection was seen in areas sprayed with Sevin. With the exception of high fir defoliation on block A59, all Sevin areas showed a high percentage of foliage saved. Good Sevin results were probably due to the long residual of the material and good deposit under marginal weather conditions.

Results with Matacil varied from very good to unacceptable. Nearly all blocks with unacceptable results had application problems with one or both applications, or in a few cases, were treated late due to weather delays or unusual development. Most Matacil blocks were acceptable or good relative to untreated areas. Some unacceptable blocks would be acceptable if back feeding on one year old foliage was considered. In some northwest blocks less than 20 percent of the 1983 foliage was saved, but in untreated areas nearby 100 percent of the 1982 foliage and 50 to 80 percent of the 1983 foliage was lost due to back feeding.

Large aircraft Matacil blocks seem to have inconsistent results probably due to unusual weather which adversely effected deposit with larger planes.

Bt was generally sprayed in areas of high to moderate population pressure and was not used under extreme conditions such as in the northwest. Most Bt treatments were good or acceptable in terms of foliage saved. Undiluted treatments with Dipel and Thuricide were as good or better than higher volume diluted applications. Nearly all Bt treatments were as effective on spruce as they were on fir. This was not true in many Matacil blocks where spruce was more heavily defoliated than fir.

Five Bt blocks in the Princeton area, treated with Dipel 6L at 64 oz., were sprayed during the long rainy period when larvae were very inactive. Post treatment checks of these blocks gave no indication of adequate treatment. All five blocks were retreated with Thuricide 32LV at 48 oz. in an attempt to achieve adequate results. Results on two of these blocks show adequate results despite the loss of significant foliage prior to the second treatment.

MAINE SPRUCE BUDWORM SURVEYS FOR 1983
AND
FORECAST FOR 1984

Following the 1983 spruce budworm feeding season, surveys were conducted to evaluate 1983 conditions and to make predictions for 1984. Surveys included an aerial defoliation survey, a population predictions survey, a ground tree condition evaluation, and an aerial tree condition survey. Data gathered in these surveys were used to establish a hazard rating for 1984 and to prepare treatment recommendations for the landowners.

AERIAL DEFOLIATION SURVEY

An aerial survey conducted in July showed extreme 1983 defoliation in unsprayed portions of Northwestern and Southeastern Maine. About a third of the sprayed portion of these areas showed light defoliation and most other spray blocks had moderate defoliation. Spray blocks in all other areas had predominately light and some moderate defoliation. Unsprayed areas in the northeast, and far southwest portions of the outbreak area showed moderate to extreme defoliation. Most of the central portion of the outbreak area had only light defoliation. In summary , the area of moderate to extreme defoliation increased slightly from 3.8 million acres in 1982 to 4.0 million in 1983. Defoliation intensity within the moderate to extreme area also increased significantly.

POPULATION PREDICTION SURVEY

The Maine 1983 population prediction survey was conducted from August through Mid-October.

In August, an egg mass survey was conducted in the northwest, southeast, and far southwest. Approximately 500 sample points were visited and samples were taken from fir and spruce. Beginning in Mid-September, the remainder of the outbreak area was evaluated with the overwintering larval method (L-II). About 500 L-II points were taken. The L-II method is used in areas where variable, low or moderate population levels were expected. Egg mass is only used in areas where uniform high population levels are expected. L-II has been a much more accurate population predictor in Maine in recent years.

Results of the 1983 population survey show large decreases in much of the infested area. Nearly all of Northern Maine had high or extreme populations in 1983, but 1983 predictive surveys show much of the area to be moderate or low. Mean predicted population levels for the north were less than half the 1982 level, but several areas of high and extreme population remain in the northwest.

Population levels were found to be very low in much of the southwest and central portions of the infestation. An area of high and extreme population was again found in the Rangeley area. In the southeast, predicted population showed a decrease from uniform high and extreme to a variable moderate and high level. Smaller low and extreme areas were also found in the southeast.

HAZARD FORECAST

A hazard rating was determined for each egg mass and L-II sample point. The system employed has been used for several years and is designed for fir. The rating includes predicted populations (from egg mass and L-II sampling), current defoliation, past defoliation (2 previous years), tree vigor, and presence of dead tops. Hazard is classed as low, moderate, high, or extreme. Points are plotted on maps and used in combination with aerial damage data to produce a final hazard map for landowners.

The portion of the budworm area in high or extreme hazard is somewhat smaller than the 1982 area (4.5 million acres in 1982 compared to 4.2 million acres in 1983). Hazard intensity has decreased in several areas due mainly to lower predicted populations. The north remains primarily in high hazard with spots of extreme. Large areas in the northeast have improved to moderate. Several years of low population and low defoliation have resulted in a lowering of hazard in the southwest and central areas. Most of this area is now in low or moderate hazard. Sprayed areas in the southeast have reduced hazard due to lower defoliation. Much of this area has been lowered from extreme to high or moderate hazard.

HOST MORTALITY

The 1983 mortality survey has not been completed, but an increase in host mortality is expected. Increases in size and mortality intensity are expected in untreated portions of the northwest and southeast. Most mortality areas mapped in the past contain 80% or more dead fir and spruce mortality is increasing.

Some areas now have more than 25% spruce mortality.

TREATMENT FORECAST FOR 1984

A treatment area of from .5 to 1 million acres is expected. Most treated land will be in the northwest and southeast. The operation will be conducted with chemical and biological insecticides.